

THE INTERNALIZATION OF PHONOLOGICAL  
RULES AS A FUNCTION OF SEX AND AGE

By  
LORRAINE IVISON MICHEL

A DISSERTATION PRESENTED TO THE GRADUATE COUNCIL OF  
THE UNIVERSITY OF FLORIDA  
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE  
DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

August, 1965



UNIVERSITY OF FLORIDA



3 1262 08552 2331

#### ACKNOWLEDGMENTS

The author expresses her sincere appreciation to Dr. McKenzie Buck for his interest and encouragement throughout their academic association. In addition, she is grateful for his assistance during the course of this dissertation.

Grateful acknowledgment is expressed to Dr. G. Paul Moore for his guidance during the author's doctoral program and the preparation of this dissertation.

The author especially thanks the administration, faculty, and students of P.K. Yonge Laboratory School. Their cooperation in making facilities and subjects available for obtaining data is appreciated.

Finally, a special word of gratitude and affection is expressed to the author's husband, John, who not only has been an invaluable aid during her course of graduate study, but whose patience and encouragement have been a constant inspiration.

## TABLE OF CONTENTS

	<u>Page</u>
ACKNOWLEDGMENTS . . . . .	ii
LIST OF TABLES . . . . .	v
 <u>Chapter</u>	
I. REVIEW OF THE LITERATURE AND PURPOSE . . . . .	1
Introduction . . . . .	1
Syntactic Rules . . . . .	1
Morphological Rules . . . . .	2
Phonological Rules . . . . .	4
Phonemic Patterning . . . . .	5
Internalization of Phonological Rules . . . . .	9
Summary . . . . .	12
Purpose . . . . .	14
II. PROCEDURE . . . . .	16
Subjects . . . . .	16
Age . . . . .	16
Location of Subjects . . . . .	17
Language Background . . . . .	20
Hearing . . . . .	21
Intelligence . . . . .	21
Speech . . . . .	22
Auditory Discrimination . . . . .	23
Experimental Procedure . . . . .	23
General Testing Procedure . . . . .	23
Visual Stimuli . . . . .	24
Verbal Stimuli . . . . .	25
Verbal Production Procedure . . . . .	25
Auditory Perception Procedure . . . . .	26
Analysis . . . . .	27
Examiner Reliability . . . . .	28
III. RESULTS . . . . .	32
Male-Female Analysis . . . . .	32
Age Group and Production-Perception Analyses . . . . .	36
Summary . . . . .	39

<u>Chapter</u>		<u>Page</u>
IV.	DISCUSSION . . . . .	42
	Discussion of Results . . . . .	42
	Observations . . . . .	45
	Implications for Further Research . . . . .	46
V.	SUMMARY AND CONCLUSIONS . . . . .	48
	BIBLIOGRAPHY . . . . .	51
	APPENDIX . . . . .	56

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1.	Ages, Intelligence Scores and Auditory Discrimination Scores for Individual Subjects in Groups A and B. The Intelligence Test Was the <u>Peabody Picture Vocabulary Test</u> for Both Groups. Group A Was Administered the <u>Tempiin Picture Auditory Discrimination Test</u> , and Group B Was Administered the <u>Wepman Auditory Discrimination Test</u> . . . . .	18
2.	Ages, Intelligence Scores and Auditory Discrimination Scores for Individual Subjects in Groups C and D. The Intelligence Test Was the <u>California Test of Mental Maturity</u> for Both Groups. Both Groups Were Administered the <u>Wepman Auditory Discrimination Test</u> . . . . .	19
3.	Summary of Individual Subject Scores (Groups A and B) for Verbal Production and Auditory Perception Tasks. Score Equals Total Number of English Not-Words. . . . .	33
4.	Summary of Individual Subject Scores (Groups C and D) for Verbal Production and Auditory Perception Tasks. Score Equals Total Number of English Not-Words. . . . .	34
5.	Values of <u>t</u> for the Evaluation of Differences Between Male and Female (In Four Age Groups) Regarding the Production of English Not-Words. . . . .	35
6.	Values of <u>t</u> for the Evaluation of Differences Between Male and Female (In Four Age Groups) Regarding the Acceptance of English Not-Words Through Auditory Perception. . . . .	35
7.	Two Way Analysis of Variance Evaluating Differences Between Types of Response and Age Groups. . . . .	37
8.	Summary of Analysis of Variance Evaluating Differences Among The Four Age Groups Regarding The Production of English Not-Words. . . . .	40
9.	Summary of Analysis of Variance Evaluating Differences Among The Four Age Groups Regarding The Acceptance of English Not-Words Through Auditory Perception. . . . .	40

## CHAPTER I

### REVIEW OF THE LITERATURE AND PURPOSE

#### Introduction

In approaching language as a system to analyze, linguists make use of three levels in its description: the syntactic, morphological, and phonological levels (2). Within these levels, Berko and Brown (2) state that a person is able to "extrapolate beyond the information he is given," or that a person can form new sentences or make up new words, but the uniqueness of this behavior still falls within the systematic patterns of the specific language. Even though the speaker must obey rules for each linguistic level when he conforms to the language he is using (2) (14) (44), the rules are not explicitly known, and the naive speaker is unaware of the linguistic regularities. While the individual's linguistic system initially follows the rules regarding the regularities in the language, the rules governing the exceptions in the language are also internalized through learning (2).

#### Syntactic rules

The syntactic rules of the English language are concerned with the 'function' of words based on the systematic relationship of words within the sentence. Within the confines of the English language it is not acceptable to say 'A very is green.' because a word functioning as a noun is required in place of 'very' (7).

Several studies have indicated that syntactic rules are abstracted and extended to new materials. An approach noting the function of 'a kind of' is shown in the following example: "\*Migs... are a kind of \*bik." Show me a \*mig (2). Furthermore, Brown (6) found that pre-school children were able to pick out a) movement when a nonsense verb-type word was used (Show me "\*sibbing."), b) an object when a nonsense noun-type word was used (What is a "\*sib?"), and c) an extended substance (a substance "having no characteristic size or shape") when a mass noun-type word was used (Do you see any "\*sib?"). Brown reports that youngsters (N = 16; ages three to five) performed better in this task than adults, and offers the explanation that the adults probably suspected something more complex. If, however, an adult is shown "\*ladiocinator," he will look for a machine, while he will look for a process or movement when hearing "\*ladiocinating" (6).

Lerea (36) has been concerned with developing a standardized procedure to measure the ability of children to express and comprehend syntactic structure through a picture language inventory. The writings of others such as Chomsky (15), Fries (22), and Glanzer (24) have added to this area.

#### Morphological rules

While syntax studies the positional relationship between words, the morphological level of language studies the formation of the words themselves (6). The rules relating to the morphological

\*All nonsense words will be indicated by an asterisk.

level are concerned with the forms of words as they "undergo modification for tense, number, case, person, etc." (12). There has been an extension of one of the morphological rules concerning past tense of a verb to new (nonsense) material when 'ed' is added to the stem in the following sequence (2): "This man is \*spowing." "This man \*spows every day. Today he \*spows. Yesterday he \*\_\_\_\_\_." Furthermore, Berko's study (1) reported that pre-school and first grade children (ages four to seven) have internalized these morphological rules. Her subjects were asked to supply "English plurals, verb tenses, possessives, derivations and compounds" for English 'not-words.' An English 'not-word' is a nonsense syllable which contains phonemic patterns or sound combinations found in English words. Since Berko felt that the use of familiar material may be studying the result of rote memory, she used English not-words ("\*wug," "\*gutch," etc.) to determine if children generalize the morphological rules to new material, thereby indicating that they have a working system of morphological rules. She concluded "that children in this age range operate with clearly delimited morphological rules," though there was a difference between the performance of pre-schoolers compared to first graders, the latter "perfecting knowledge they already had" as pre-schoolers. Since there was no male-female performance difference for each age level, Berko theorized that the internalization of morphological rules was a cognitive process, probably "related to intelligence more than to any other feature."

### Phonological rules

The phonological level, concerned with the sound system of the language, is another level of language with systematic patterns and rules (6). In each language there are a certain number of classes of speech sounds which are called 'phonemes,' and which are characteristic of that language (46). While it is generally theorized that no sound is articulated twice in exactly the same manner, if the intended sound falls within the perceived, acceptable limits of the abstract entity referred to as that sound, it is considered to be that sound. Therefore every speech sound can be assigned theoretically to one (and only one) of the phonemes of the language. Thus though a [t] sound may be dentalized, or aspirated, or differ because of the vowel it precedes, it is considered to be the phoneme /t/. Halle (25), Swadesh (46), and others (2) (5) (6) (26) (33) (42) (52) discuss many specific rules on the phonological level of the English language. For example, the phoneme /ŋ/ is always preceded by a vowel sound, and therefore never occurs in the initial position in a word; two plosive sounds do not occur together at the beginning of a word (as /kp/, or /tk/, etc.); words are not initiated by /nk/, /pw/, or other "logically possible combinations" (2). Other phonological rules state that the following phonemes never occur as members of initial clusters: /v/, /ð/, /z/, /tʃ/, /dʒ/, and /ʒ/; and /l/ never follows /t/, /d/, /θ/, /ʃ/, /h/, or /sk/ in initial clusters. In general, the phonological rules relate to permitted or acceptable patterns of phoneme combinations (2).

### Phonemic patterning

Cherry (14) states that when a person has learned to speak his native language, he "has developed the faculties both of making the required sounds, and patterning them into sequences." Jakobson (11), Jakobson and Halle (33), and Leopold (35) refer to phonemic patterning as the developmental aspect of sound category acquisition. That is, they theorize that types of sounds develop in a sequential order in a child due to physiological maturation, and this sequential order generalizes over many language systems. However, for the purposes of this paper, Bloomfield's definition (4) of phonemic patterning will be used: "The orders [of phonemes] which occur are sound patterns of a language." There are two major aspects to phonemic patterning: a) What is the probability of the appearance of the sound in a specific position or sequence? and b) Does the sound ever occur in a specific position or sequence? Different phonemes do not occur with the same frequency, nor do they necessarily follow one another (2). Bloomfield (4) makes the assumption that "the number of orders of phonemes in the morphemes and words of a language is a sub-multiple of the number of possible orders," and therefore it is evident that there are many possible phonemic patterns that do not occur at all in the English language (2). The frequency characteristics of the phonemes of a language "are eventually absorbed by a person" (2).

In regard to the first aspect of phonemic patterning (the probability of a phonemic pattern or a phoneme in a specific position), the frequency of specific phonemes has been studied

primarily in an attempt to find "inherent mathematical lawfulness" (11). However, such data are not only dependent upon the inherent characteristics of the language, but also upon the subject being discussed (11), the method used for communication (speaking, writing, etc.), and the audience to which the material is presented. Investigators (19) (28) have studied the frequency of occurrence of phonemes in various ways--telephone conversations, printed material, etc. Hayden (28) obtained the frequency of phonemes from a series of six lectures concerning the English language, and noted that the most frequently used phoneme was /ə/, followed by /ɪ/, /n/, /t/, /r/, /s/, /l/, /dʒ/, and /d/. The phoneme most infrequently used was /ʒ/. The range of the frequency distribution (regarding position and combination) is considered to be a characteristic of each phoneme (46). There is, therefore, a high degree of dependency of the occurrence of one phoneme upon the occurrence of the next (11). Saporta (43) states that "these deviations from chance [of occurrence for phonemes] are not random, but are governed by some 'lawful' principle." Basing his analysis of sounds on Jakobson's binary principle where any phoneme can be described in a binary manner (consonant/non-consonant; nasal/oral; tense/lax; etc.), Saporta found that in any consonant sequence, the phoneme patterns allowing for the least effort for the speaker are those in which successive phonemes are most similar in type. However, this requires a good deal of effort by the listener. Minimal listener effort occurs when the successive phonemes are the least similar, thereby eliminating the necessity of fine discrimination.

Thus Saporta hypothesized that "the average frequency of a consonant cluster is a function of the difference [in similarity] between the phonemes in a cluster." Extremely similar or dissimilar phoneme patterns result in a low frequency of occurrence for that pattern, while patterns at neither extreme occur with high frequency. He found that the distribution of clusters followed a normal curve. Carroll (13) agreed with Saporta's work, and added that there is the possibility that a single non-similar feature (such as voicing) rather than numerous features may account for the low frequencies.

Brown and Hildum (9) found that when adult subjects, uninstructed in linguistics, hear speech that they expect to be their native language, their knowledge of sequential probabilities of phonemes influences their perception. Thus a not-English word (the combination of sounds does not occur in English words, as "\*zdrol/" and "\*pwen/") was identified correctly very few times because the phonological expectancy was misleading. Furthermore, if subjects were mistaken regarding two or more phonemes in a nonsense syllable, the subjects almost always identified it as a conventional English word. If subjects were mistaken on one phoneme only, there was an equal possibility of the response being a word or a nonsense syllable. Students of linguistics also listened to the nonsense stimuli, and correctly identified four times as many English not-words, and eleven times as many not-English words.

The second aspect of phonemic patterning, the probability of a sound occurring in a position or cluster versus the probability of the sound never occurring in the English language in that position or cluster, has also been investigated. Whorf (52) has constructed a formula for possible words of one syllable in the English language that is based on the phonemic patterns of already existing English words. According to Brown (8), the Whorf formula "summarizes cultural practice rather than human necessity" in that not-English phonemic combinations do not occur because they are initially too hard to pronounce. Thirty adult native speakers of American English were asked by Brown (6) to invent new one-syllable English words, and he found that most of the inventions were "possible" according to Whorf's formula except two: /bz/ and /zl/.

Since the publication of Whorf's formula, several of his suggested not-English combinations have apparently come into use. This fact can be related to the findings by Fries and Pike (23), Haugen (27), and others (33) who note that the speech of monolingual natives of some languages is comprised of more than one phonemic system. If there is contact between two societies speaking different languages, individuals will borrow sequences from the not-native linguistic system, and use them in the context of their native system. This usage results in linguistic changes (interference) in the native language system (20) (27) (49). Fries and Pike (23) state that one cannot tell if the phonemic pattern is a "loan" pattern (that is, from another language)

until the two systems are phonemically compared. That is, there is the possibility that one language is phonemically unsystematic, or that the excluded data are part of a co-existing system. A loan sequence of phonemes is considered to be assimilated or integrated when the words containing the not-English sequence are in common use by monolinguals (20) (23). Thus /ʃ/ sequences such as /ʃn/, /ʃm/, and /ʃl/, which are not-English according to Whorf, might be considered to fall in the category of assimilated phonemic patterns in the English language: schnook, Schneider, shmoo, schmaltz, schlemiel, and Schlitz (9) (23). Initial /ʒ/, as in Gigi, would appear to have been assimilated into the English language (42), as would /sr/ as found in the regional pronunciation of 'shrimp,' /srImp/. The combination /zw/, as found in the word 'zweibach,' and /skl/ as in the word 'sclaff' (40) are additional examples.

#### Internalization of phonological rules

Cherry (14) states that people acquire "deeply ingrained habits" of speaking phonemic sequences. He and Sapir (42) theorize that these habits can be detected when there is observable difficulty in speaking a foreign language. Contreras and Saporta (17) noted, in a study of native Chilean-Spanish speakers, that the subjects were able to perceive not-Spanish phonemic combinations better than they were able to produce these same combinations. While children easily seem to master a foreign language, this learning is often impossible for adults. This fact can be related either to a) the adults' inability to construct new linguistic

rules by extrapolating from the information relating to the foreign language, or b) to the inability to articulate new phonemic patterns because adults automatically convert heard speech into sounds of their own language (34) (46) (52).

Hockett (31) states that a youngster is in the process of acquiring his complete phonemic patterns until the stage of puberty ("the early teens"). He further states that puberty is related to a loss of linguistic flexibility, wherein a person finds the sounds of his language "right" and the sounds of a foreign language "wrong." Prior to this stage, a youngster accommodates easily to new linguistic environments, is easily influenced by the language of other children, and can easily be persuaded to re-classify a "wrong" speech sound as "right." Joos (34) agrees that a child's linguistic habits stabilize between the ages twelve to fourteen years, prior to which he can learn a second language perfectly. According to Ivanov (32), Vygotsky (sic) views the "awareness of the rules of the native language" as "a turning point in the life of the child and marks his transition to the logical thinking of the adult." However, both Ivanov (32), and Jakobson and Halle (33) state that phonemic rules have been mastered in the earliest years of childhood and then become involuntary. Furthermore, Whorf (52) and Carroll (12) claim that the phonological rules are being learned between the ages of two and five, and thus are "ingrained and automatic" (52) by the age of six. Any new words that children make all are derived from the same formula and follow phonological

rules for the English language. Finally, Berko and Brown (2) state that "most phonological learning occurs in the first three years of life." Thus theories differ as to the age by which the internalization of phonological rules has occurred. Brown (8) and others (2) (41) note that early vocalization of children develops toward the speech patterns of the family because the family reinforces the approximations of cultural sound patterns as early as the babbling state (41). Velten (48) states that "a child does not acquire a phoneme system by random selection or by taking it over ready-made from the language of the adults, but by proceeding step by step, from the greatest possible phonemic distinction to smaller and smaller differentiations."

Berko and Brown (2) feel that the internalization of phonological rules can be shown to exist when a child is asked "to make up words and see whether his creation follows the phonological rules of language." Berko (1) noted from her study of the internalization of morphological rules that the children performed best in forming plurals "on the items where general English phonology" determined which of the allomorphs of plurality was required. That is, the children followed a voiceless consonant with the voiceless plural form /s/, and a voiced consonant with the voiced plural form /z/. This behavior, according to Berko, demonstrated that children four to seven years of age have internalized phonological rules.

The verbal production of words, or making up new linguistic forms which extend phonological rules, and the perception or the acceptance of invented forms which extend phonological rules, may

not necessarily be equally developed in individuals. It has been suggested (2) that perceptive control precedes productive control in the development of the phonological system. Thus it might be possible that youngsters of a certain age level would be able to perceive not-English combinations as being 'impossible' (or highly improbable) words, and yet produce not-English combinations when requested to make up words.

### Summary

A review of the literature has demonstrated that a number of studies have been concerned with the problem of the internalization of syntactic and morphological rules by youngsters. The data in these studies were obtained by analyzing the extension (or application) of syntactic and morphological rules to new or nonsense material. New material was used as it was thought to provide an opportunity for the application of the rules, while it was thought that the use of familiar material may only be testing the result of rote learning. The new material allowed for responses stemming from the subject's own imagination, in terms appropriate to his own "private, idiosyncratic meaning and organization" (30).

Frequency counts of phonemes and phonemic patterns have been studied to note which phonemes are more often used. Furthermore, a hypothesis suggesting a basis for the frequency of phonemic patterns has been proposed by Saporta. Investigators have determined that adults have internalized the sequential probabilities of phonemes,

and are thereby influenced in the auditory perception of verbal stimuli. Thus it has been suggested that adults convert heard speech into the patterns of their own language. Other investigators have studied the phonological rules of the English language, and have listed many of the phoneme patterns that are not possible within the English language. Whorf went one step further by devising a formula for possible English combinations of one syllable words. That the number of possible phonemic patterns of the English language is constantly subject to change is supported by the current use of phonemic patterns which were considered to be 'impossible' according to Whorf's formula or to the writings of others.

It has been generally assumed that the internalization of phonological rules has occurred by adulthood. However, there are several different hypotheses suggesting by which specific age this internalization has occurred: early teens (Hockett (31) and Joos (34) ), age six (Whorf (52) and Carroll (12) ), and age three (Berko and Brown (2) ). However, there have been no studies reported in the literature with the purpose of determining at which specific age the internalization of phonological rules has occurred. This information would contribute markedly to the body of knowledge concerned with the process of language learning. It has also been hypothesized that individuals perceive differences between English and not-English phonemic patterns, accepting only the former patterning, prior to the stage at which the words they make up extend

the phonological rules. Research providing support for this hypothesis is necessary.

The study of the internalization of phonological rules can be applied to many different areas such as mental retardation, speech pathology, reading problems, foreign language learning, etc. While most authors agree that phonological rules have been internalized by adulthood, it appears to be of primary importance to supply data concerning the age by which the 'average' normal child has internalized these rules, thereby perhaps determining which of the theoretical positions previously discussed is most tenable. It would also be of interest to note whether the male-female similarity in regard to the extension of morphological rules, as found by Berko, also applies with the extension of phonological rules. Since different degrees of internalization of phonological rules may exist when comparing the auditory perception with the verbal production of material extending phonological rules, it would be of additional interest to study this aspect of the internalization of phonological rules in regard to the 'average' normal child.

#### Purpose

It was the purpose of this study to investigate the extension of internalized phonological rules in relation to the sex and chronological age of the 'average' normal child. To accomplish this purpose the following specific questions were asked.

1. Is there a significant difference between the performance of males and females in selected age groups regarding the adherence

to internalized phonological rules when asked to produce new words verbally?

2. Is there a significant difference between the performance of males and females in selected age groups regarding the adherence to internalized phonological rules as shown by the acceptance through auditory perception of new material extending phonological rules?

3. Is there a significant difference among four age groups regarding the internalization of phonological rules?

4. Is there a significant difference between the extension of phonological rules by means of verbal production and by means of auditory perception within or among the four different age groups?

## CHAPTER II

### PROCEDURE

In order to study the relation of the internalization of phonological rules to the sex and chronological age of the 'average' child, the following procedures were carried out.

#### Subjects

Twenty subjects (ten Caucasian males and ten Caucasian females) were selected for each of four different age groups, resulting in a total sample of eighty subjects. These subjects, selected from one hundred and forty-four individuals tested, met the criteria regarded as necessary for subject selection. The criteria, the age of the subject, language background, hearing acuity, intelligence, articulation proficiency, and auditory discrimination ability, are described below.

Age. Group A. The male subjects in Group A ranged in age from 3 years 1 month to 3 years 11 months, with a mean age of 3 years 6 months. The female subjects ranged in age from 3 years 2 months to 3 years 11 months, with a mean age of 3 years 6 months. Mean age for the twenty subjects in Group A was 3 years 6 months.

Group B. The male subjects in Group B ranged in age from

6 years 4 months to 7 years 3 months, with a mean age of 6 years 10 months. The female subject age range was 6 years 3 months to 7 years 3 months, with a mean age of 6 years 10 months. Mean age for the twenty subjects in Group B was 6 years 10 months.

See Table 1 for ages, intelligence scores, and auditory discrimination scores for individual subjects in Groups A and B.

Group C. The male subjects in Group C ranged in age from 13 years 6 months to 14 years 3 months, with a mean age of 13 years 11 months. The female subject age range was 13 years 4 months to 13 years 10 months, with a mean age of 13 years 7 months. The mean age for the twenty subjects in Group C was 13 years 9 months.

Group D. The male subjects in Group D ranged in age from 17 years 5 months to 18 years 9 months, with a mean age of 17 years 10 months. The female subject age range was 17 years 6 months to 18 years 11 months, with a mean age of 18 years. Mean age for the twenty subjects in Group D was 17 years 11 months.

See Table 2 for ages, intelligence scores, and auditory discrimination scores for individual subjects in Groups C and D.

Location of subjects. All subjects were either attending or registered to attend P.K. Yonge Laboratory School associated with the University of Florida.

The subjects in Group A were registered for admittance to this school. A letter (see Appendix), co-signed by the principal of P.K. Yonge and the Chairman of the investigator's graduate

TABLE 1. Ages, intelligence scores and auditory discrimination scores for individual subjects in Groups A and B. The intelligence test was the Peabody Picture Vocabulary Test for both groups. Group A was administered the Templin Picture Auditory Discrimination Test, and Group B was administered the Wepman Auditory Discrimination Test.

Group	Age	Intelligence Score	Aud. Disc. Score*	Group	Age	Intelligence Score	Aud. Disc. Score
A. Female				B. Female			
1.	3-2	90	46	1.	6-3	105	2/30 0/10
2.	3-2	95	46	2.	6-6	104	4/30 2/10
3.	3-4	113	53	3.	6-8	106	0/30 0/10
4.	3-5	108	43	4.	6-8	102	4/30 1/10
5.	3-6	93	44	5.	6-9	110	5/30 0/10
6.	3-6	110	55	6.	6-9	110	5/30 0/10
7.	3-6	99	48	7.	6-11	102	4/30 0/10
8.	3-6	113	50	8.	7-1	100	3/30 0/10
9.	3-10	107	55	9.	7-3	110	4/30 0/10
10.	3-11	96	48	10.	7-3	98	2/30 0/10
Mean	3-6	102.4		Mean	6-10	104.7	
A. Male				B. Male			
1.	3-1	114	49	1.	6-4	107	1/30 2/10
2.	3-2	104	47	2.	6-8	100	2/30 0/10
3.	3-4	105	48	3.	6-8	93	5/30 2/10
4.	3-5	101	47	4.	6-9	96	1/30 0/10
5.	3-6	94	51	5.	6-9	112	2/30 0/10
6.	3-6	87	47	6.	6-10	106	3/30 0/10
7.	3-7	107	53	7.	6-11	102	3/30 0/10
8.	3-8	114	51	8.	6-11	100	4/30 0/10
9.	3-11	116	48	9.	7-3	108	4/30 0/10
10.	3-11	110	55	10.	7-3	104	1/30 0/10
Mean	3-6	105.2		Mean	6-10	102.8	
Total				Total			
Mean	3-6	103.8		Mean	6-10	103.75	

\*Templin norms: Age 3: Mean = 45.6 Standard Deviation = 5.58  
 Age 3.5: Mean 47.0 Standard Deviation = 5.06

TABLE 2. Ages, intelligence scores and auditory discrimination scores for individual subjects in Groups C and D. The intelligence test was The California Test of Mental Maturity for both groups. Both groups were administered the Wepman Auditory Discrimination Test.

Group	Age	Intelligence Score	Aud.Disc. Score	Group	Age	Intelligence Score	Aud.Disc. Score
C. Female				D. Female			
1.	13-4	94	2/30 0/10	1.	17-6	100	3/30 0/10
2.	13-5	96	3/30 0/10	2.	17-7	92	3/30 1/10
3.	13-6	97	3/30 1/10	3.	17-7	92	3/30 0/10
4.	13-6	104	1/30 0/10	4.	17-10	99	1/30 0/10
5.	13-7	99	2/30 0/10	5.	17-11	106	2/30 1/10
6.	13-8	110	1/30 0/10	6.	18-0	105	3/30 0/10
7.	13-8	99	2/30 0/10	7.	18-0	107	3/30 2/10
8.	13-9	100	3/30 1/10	8.	18-2	92	1/30 0/10
9.	13-9	104	2/30 0/10	9.	18-2	103	2/30 1/10
10.	13-10	103	3/30 0/10	10.	18-11	93	1/30 0/10
Mean	13-7	100.6		Mean	18-0	98.9	
C. Male				D. Male			
1.	13-6	103	1/30 0/10	1.	17-5	91	1/30 1/10
2.	13-8	105	2/30 0/10	2.	17-6	106	3/30 0/10
3.	13-9	98	3/30 0/10	3.	17-6	109	2/30 0/10
4.	13-11	98	1/30 1/10	4.	17-8	108	1/30 0/10
5.	14-0	101	3/30 0/10	5.	17-8	96	2/30 1/10
6.	14-0	108	3/30 1/10	6.	17-10	104	1/30 0/10
7.	14-1	94	2/30 0/10	7.	17-11	102	2/30 0/10
8.	14-1	103	2/30 0/10	8.	17-11	106	2/30 0/10
9.	14-3	102	0/30 0/10	9.	18-6	100	2/30 0/10
10.	14-3	104	2/30 0/10	10.	18-9	98	3/30 0/10
Mean	13-11	101.6		Mean	17-10	102.0	
Total				Total			
Mean	13-9	101.1		Mean	17-11	100.45	

committee, was sent to the parents of each of these pre-school children requesting their cooperation in the study.

The subjects in Group B attended first grade and were selected from two classes within that grade. The subjects in Group C attended eighth grade and were selected from three classes within that grade. The subjects in Group D attended twelfth grade and were selected from three classes within that grade. This group of subjects was considered to be of 'adult' age.

Although the subjects may have had siblings at the same school in other age groups tested by the investigator, no more than one youngster of a family was selected.

Language background. All of the subjects used in this study had learned American English as their initial language, in a home where no foreign language was spoken. The investigator was not concerned with relatives who spoke a foreign language provided that the relative did not reside in the home of the subject. Further, no concern was given to second languages learned as part of the high school education program.

All subjects in Groups A, B, and D, and all the female subjects in Group C were born in and had resided only in the United States. One male subject in Group C had been born in English-speaking Canada, moving to the United States shortly thereafter. Though a second male subject in Group C had resided for one year in France, he lived on a U. S. Army base and was therefore in an English-speaking environment.

Hearing. Each subject passed a hearing screening test in both ears at 20 db at 500, 1000, 2000, 4000, and 6000 cps. The audiometer used was a portable Beltone model 12AC. From this screening procedure it was assumed that the hearing of each subject was within normal limits.

Intelligence. Group A. The subjects in Group A were administered the Peabody Picture Vocabulary Test, Form A (21). The resulting IQ scores for the male subjects ranged from 87 to 116, with a mean IQ of 105.2. The resulting IQ scores for the female subjects ranged from 90 to 113, with a mean IQ of 102.4. Because there was over a three point difference between male and female mean IQ scores, a t test was computed which revealed no significant difference ( $t = .73$ ;  $t_{.05} = 2.10$ ;  $df = 18$ ) between the IQ scores of the male and female subjects. The mean IQ score for the twenty subjects in Group A was 103.8.

Group B. Each subject in Group B was given the Peabody Picture Vocabulary Test, Form A (21). The resulting IQ scores for the male subjects ranged from 93 to 112, with a mean IQ score of 102.8. The resulting IQ scores for the female subjects ranged from 98 to 110, with a mean IQ score of 104.7. The mean IQ score for the twenty subjects in Group B was 103.75.

Group C. The results of the California Test of Mental Maturity (1957 Revision) (45), administered by the P.K. Yonge Guidance Department in November of 1963, were used for each of the subjects in Group C. The male subjects' scores ranged from

94 to 108, with a mean IQ score of 101.6. The female subjects' scores ranged from 94 to 110, with a mean IQ score of 100.6. The mean IQ score for the twenty subjects in Group C was 101.1.

Group D. The results of the California Test of Mental Maturity (1957 Revision) (16), administered by the P.K. Yonge Guidance Department in November of 1963, were used for each of the subjects in Group D. The male subjects' scores ranged from 91 to 109, with a mean IQ score of 102.0. The female subjects' scores ranged from 92 to 107, with a mean IQ score of 98.9. Because there was a difference of over three points between male and female mean IQ scores, a t test was computed which revealed no significant difference ( $t = 1.22$ ;  $t_{.05} = 2.10$ ;  $df = 18$ ) between the IQ scores of the male and female subjects. The mean IQ score for the twenty subjects in Group D was 100.45.

Speech. The Hejna Developmental Articulation Test (29) was administered to each subject. The articulation proficiency of all subjects was adequate for their chronological age according to Hejna's normative data for articulation development.

All twenty subjects in Group A had errors of articulation, but the articulation of all these subjects was acceptable for their chronological age. In Group B, two out of ten female and six out of ten male subjects had errors of articulation. However, the articulation of all was also acceptable for their chronological age. The subjects in Groups C and D had no articulation errors on the articulation test.

Auditory discrimination. All subjects had adequate auditory discrimination ability for their chronological age.

Group A. The subjects in Group A were administered the Templin Picture Auditory Discrimination Test (47), and the second or B scoring method was used. Only those scores were accepted which fell within or were better than minus one standard deviation from the mean score according to the Templin norms for this test.

Groups B-D. The subjects in Groups B to D were administered the Wepman Auditory Discrimination Test (50), and all scores fell within acceptable limits for chronological age according to the Wepman norms for the test.

#### Experimental procedure

General testing procedure. The subjects were tested individually by the investigator, Groups B to D in a quiet room in the Guidance Department at P.K. Yonge, and Group A in a sound-treated room at the Speech Department at the University of Florida.

Each subject in Group A was accompanied by a parent throughout the entire testing procedure, thereby eliminating the possibility of fear on the part of the subject due to a lack of knowledge of the location of the parent. In many cases the parent encouraged the youngster to participate in the various test procedures, but in no case did the parent overtly influence the responses of the subject.

The order of test presentation was as follows: hearing, intelligence (Groups A and B), speech, auditory discrimination,

experimental verbal production task, and experimental auditory perception task. The verbal production task preceded the auditory perception task to avoid a possible influence of the nonsense words used by the investigator on the words made up by the subject. If, in Group A, a subject was not willing to complete the hearing test, the next test was administered, the hearing test being completed when the child was ready to continue with it. There were no other deviations from the order of test presentation.

Visual stimuli. Fifty nonsense pictures were drawn in India ink on 5 X 7 white cards by a student majoring in art at the University of Florida. The fifty drawings were then seen by ten judges (faculty of the Department of Speech and advanced graduate students in speech at the University of Florida) who individually selected the twenty-two drawings which to them least resembled any known object or being. The twenty-two nonsense pictures (see Appendix) with the highest number of votes were then used for the experimental stimuli, each picture having received five or more votes. The nonsense pictures were arbitrarily divided into three groups of two, ten, and ten. The two pictures were used when examples were needed in the experimental verbal production procedure, and the latter two groups of ten pictures served as the stimuli for the verbal production and auditory perception procedures. In that the nonsense pictures had no words which could be used to refer specifically to them, they served as a point of reference from which the subjects could auditorily perceive or create nonsense words.

Verbal stimuli. In order to determine the application of phonological rules through the auditory perception of invented forms, ten pairs of words were presented. Each pair was presented in the question form 'Is this a \_\_\_\_ or a \_\_\_\_?', thereby prompting the subject to make a choice. In each question was one English not-word and one not-English word, randomly ordered. Thus there were ten nonsense syllables containing not-English phonemic patterns in the initial position, and ten nonsense syllables containing English phonemic patterns, the English not-words corresponding to the not-English words in medial vowel and final consonant sounds. The nonsense syllables selected were a modification of the list of syllables used by Brown and Hildum (9), modified to eliminate the possible English phoneme combinations /ʃl/ and /sr/ for reasons previously discussed. The pairs of words, and the position of each, are found in the Appendix.

Verbal production procedure. Each subject was told that he was going to see some pictures that had no words for them, and that he was to make up a word for each picture. The subject was then shown the first of a series of ten 5 X 7 white cards with India ink drawings of nonsense pictures, and his response recorded. If the subject was unable to make up a nonsense word, or did not understand the task, he was told that a pretend or make-believe word, not a real word, was required. If these suggestions did not help, he was asked to say a silly word, and then asked to put sounds together to make a word. If the subject was still

unable to perform the task, the two pictures to be used for examples were shown. Picture A was called a "\*wug," and picture B a \*klof. The subject was then told that no other picture was called "\*wug" or \*klof because no other picture looked the same as these two. Picture #1 was then again shown in order to elicit a response from the subject. If the individual was still unable to perform the task, he was not used as a subject in this study. No further examples were given. For the individuals who did make up a word for the first picture, the remaining nine pictures were shown in succession. Each picture was presented for approximately five seconds. The same pictures were always used for this procedure, and the pictures were always presented in the same order. After viewing the picture, the subjects had as long an amount of time as desired to make up a word, and as much encouragement as was necessary for them to complete the task was given by the investigator.

All responses were phonemically transcribed by the investigator using symbols from the International Phonetic Alphabet (I.P.A.). At the same time all responses were tape recorded using a Wollensak model T-1500 tape recorder and new magnetic recording tape (Scotch all purpose Tenzar #175 tape).

Auditory perception procedure. Each subject in Groups A-D was told that the investigator had made up two words for each of ten new pictures, and that the subject was to choose which of the two words he felt was the better one for that picture. The subjects were requested to indicate their choice of word by responding 'first'

or 'second' instead of repeating the preferred word. The second series of ten drawings was then shown in the same manner as the first, the subject being asked for each drawing: 'Is this a \_\_\_\_\_ or a \_\_\_\_\_?' The investigator paused slightly before and after each nonsense word.

In addition to the above instructions, the subjects in Group A were presented with three pictures of known objects prior to being presented with the nonsense pictures. The known objects were cup, car, and boy. The investigator asked each subject:

1. Is this a /kʌp/ or a /lʌp/?
2. Is this a /tɑr/ or a /kar/?
3. Is this a /fɔl/ or a /bɔl/?

Correct responses by the subjects to these three questions indicated to the investigator that the three-year-old subjects were waiting for both stimuli to be presented for each picture, and that the subjects would verbalize a preferred word.

Analysis. For analysis the number of English not-word responses was totaled and tabulated for each subject under the two conditions of verbal production and auditory perception. Thus if a subject responded with an English not-word to every stimulus, he would have a score of ten for verbal production and a score of ten for auditory perception.

To determine whether there was a significant difference between male and female performance on the verbal production procedure within each age group, t tests were computed. The presence or absence

of significant differences between males and females in each age group in regard to the auditory perception of English not-words was determined by t tests also. A two-way analysis of variance was computed to investigate possible differences among age groups, and between type of response (perception and production). Additional F tests were computed to investigate further possible differences among age groups for each type of response.

Examiner reliability. Method 1. As previously mentioned, the ten verbal nonsense words produced by each subject were tape recorded at the time of presentation. The investigator then selected the sixteen best recordings (20% of all recordings), two male and two female from each of Groups A to D. Criteria for selection were a) minimal background noise, and b) clarity of subject response. Using the same recorder, the investigator listened to the recordings of these sixteen subjects, phonemically transcribing all responses in I.P.A. symbols. A comparison was then made of the initial transcription (which occurred in the presence of the subject) with the transcription of the recorded response. It is recognized that the investigator had both auditory plus visual cues at the time of the initial presentation, and only auditory cues (the tape recording) during the second transcription. An agreement of 94% was found between the two transcriptions.

Method 2. The original tape included subject identification, grade or age of the subject, and the ten responses (nonsense words made up by the subject). The recordings were made in relatively

quiet rooms in a school environment, but background noise (typing, bells, voices, etc.) was unavoidable. Therefore the original tape contains instances of interference.

The responses of the sixteen selected subject recordings (as discussed previously) were dubbed onto new tape from an Ampex model 354 two channel recorder through a Marantz model 7 pre-amplifier and a Marantz model 8B power amplifier to a Magnecord model M-90-A single channel recorder. During this rerecording all responses were monitored in order to equalize intensity levels. Each of the ten responses for each subject was dubbed twice in succession on the reliability tape, each reproduction being as free from surrounding background noise as possible. Thus word #1 of subject #1 appeared twice in succession, word #2 of subject #1 then appeared twice in succession, and so on for the remaining responses for each of the sixteen subjects. The sixteen series of responses were presented randomly by subject so that there was no grouping of age or sex. Each new subject series was identified by a subject number (one to sixteen) prior to the presentation of the responses. It must be recognized that the reliability tape had decided limitations in presentation of the subjects' responses. All background noise could not be eliminated as it occasionally occurred during the response, and some initial or final consonants or syllables could not be heard on the tape due to the inconsistent intensity level of initial response combined with the background noise.

The reliability tape was played on an Ampex model 350 tape recorder through a Marantz model 7 pre-amplifier and Marantz model

8B power amplifier system. The output of this amplifier was fed to an AR-3 speaker system located in an IAC model 403-A sound treated room. Three faculty members in the Department of Speech at the University of Florida were selected as judges, all having had extensive experience in speech clinical work. These judges, along with the investigator, listened in the IAC model 403-A sound treated room to the reliability tape, and phonemically transcribed the responses using I.P.A. symbols. The presentation of the tape was controlled by a Research Associate in the Speech Department who allowed approximately two seconds between the repetition of a response, and enough time for the judges to transcribe their responses before the next stimulus was presented.

The responses transcribed from the reliability tape by the investigator were compared with those of the three judges, and a percentage of agreement with each of the judges was obtained. Agreement with judge A was 80%, with judge B it was 78%, and with judge C 64%. Average agreement with the three judges was 74%. The investigator agreed with at least one of the three judges 92% of the time, with at least two of the three judges 78% of the time, and with all three judges 52% of the time. One probable cause for lack of agreement among judges was the influence of the background noise on the perception of consonants, special difficulty being noted in making discriminations between such phonemes as /f/ and /θ/, /m/, /n/, and /ŋ/, etc. Therefore total agreement was based on the number of syllables of the word, similarity of vowel sound, and

similarity of consonant sound.

## CHAPTER III

### RESULTS

This chapter presents the results obtained by the statistical analyses of the verbal production and auditory perception tasks described in Chapter II.

As previously mentioned, in the verbal production procedure each subject was asked to make up ten nonsense words, and a score equal to the number of English not-words was recorded for each subject. (See Appendix for listing of the not-English words produced.) Each subject also listened to the investigator verbally present ten pairs of nonsense words, each pair comprised of one word with a not-English phonemic pattern in the initial position and one word with a possible English phonemic pattern in the initial position. The subject chose which word of the pair he felt was the better one for the nonsense picture. A score for each subject equal to the number of English not-words chosen by the subject was recorded. Thus it was possible for a subject to obtain two scores each from 0 to 10, one score for the verbal production procedure and one for the auditory perception procedure. The scores for all subjects were tabulated and arranged in Tables 3 and 4.

#### Male-female analysis

Table 5 presents the results of  $t$  tests comparing the

TABLE 3. Summary of individual subject scores (Groups A and B) for verbal production and auditory perception tasks. Score equals total number of English not-words.

Group	Verbal Production	Auditory Perception	Group	Verbal Production	Auditory Perception
<b>A. Female</b>					
1.	10	2	1.	10	4
2.	10	4	2.	10	4
3.	10	7	3.	8	6
4.	10	5	4.	10	4
5.	10	5	5.	10	5
6.	10	6	6.	10	8
7.	9	5	7.	9	8
8.	10	5	8.	10	4
9.	10	5	9.	10	5
10.	10	5	10.	10	8
Mean	9.9	4.9	Mean	9.7	5.6
<b>A. Male</b>					
1.	10	7	1.	10	5
2.	10	7	2.	7	6
3.	10	4	3.	10	4
4.	10	7	4.	10	9
5.	10	5	5.	10	7
6.	10	6	6.	9	8
7.	10	4	7.	10	7
8.	10	3	8.	10	8
9.	10	5	9.	10	9
10.	10	3	10.	10	5
Mean	10.0	5.1	Mean	9.6	6.8

TABLE 4. Summary of individual subject scores (Groups C and D) for verbal production and auditory perception tasks. Score equals total number of English not-words.

Group	Verbal Production	Auditory Perception	Group	Verbal Production	Auditory Perception
C. Female			D. Female		
1.	10	2	1.	9	7
2.	10	6	2.	10	6
3.	10	9	3.	10	7
4.	10	6	4.	10	6
5.	10	9	5.	9	8
6.	10	4	6.	10	3
7.	10	4	7.	9	4
8.	10	6	8.	10	6
9.	10	6	9.	10	7
10.	10	3	10.	10	4
Mean	10.0	5.5		9.7	5.8
C. Male			D. Male		
1.	10	8	1.	10	4
2.	9	4	2.	10	5
3.	10	8	3.	10	10
4.	9	3	4.	10	5
5.	9	6	5.	10	5
6.	10	2	6.	10	5
7.	9	3	7.	10	5
8.	10	5	8.	10	8
9.	10	5	9.	10	6
10.	10	6	10.	10	3
Mean	9.6	5.0	Mean	10.0	5.6

TABLE 5. Values of  $t$  for the evaluation of differences between male and female (in four age groups) regarding the production of English not-words.

Comparison Male/Female	$\bar{X}_1 - \bar{X}_2$	df	t	$t_{.05}$
Group A	0.1	18	0.31	2.10
Group B	0.1	18	0.29	
Group C	0.4	18	0.00	
Group D	0.3	18	0.77	

TABLE 6. Values of  $t$  for the evaluation of differences between male and female (in four age groups) regarding the acceptance of English not-words through auditory perception.

Comparison Male/Female	$\bar{X}_1 - \bar{X}_2$	df	t	$t_{.05}$
Group A	0.2	18	0.32	2.10
Group B	1.2	18	1.60	
Group C	0.5	18	0.54	
Group D	0.2	18	0.26	

male-female scores for the verbal production of English not-words within each of the four age groups. Values of .00 to .77 fall below the  $t_{.05}$  level of 2.10. Thus there is no statistically significant difference between male and female performance on this task for any of the four age groups. The lack of a significant difference justifies combining the male and female scores in further analyses involving this task.

Table 6 presents the results of  $t$  tests comparing the male-female scores for the acceptance of English not-words through auditory perception within each of the four age groups. Obtained values of .26 to 1.60 fall below the 2.10 needed for significance at the .05 level. That no statistically significant difference was found between male and female performance within any age group justifies combining the male and female scores in further analyses of this task.

That no differences were found between males and females at any of the four age levels for either task indicates that, for this aspect of language learning, the often found trend for males to acquire language skills slower than females apparently does not hold true.

#### Age group and production-perception analyses

Table 7 presents the results of a two-way analysis of variance computed to test for differences among age groups, and between verbal production and auditory perception in regard to the extension of phonological rules. An obtained  $F$  ratio of 1.02 indicates no

TABLE 7. Two way analysis of variance evaluating differences between types of response and age groups.

Source	ss	df	ms	F	F <sub>.05</sub>
Type of Response	731.03	1	731.03	413.01	3.84
Age Groups	5.40	3	1.80	1.02	2.60
Interaction	12.27	3	4.09	2.31	2.60
Error	268.40	152	1.77		
Total	1017.10	159			

statistically significant differences ( $F_{.05} = 2.60$ ) among age groups for total task performance. Finding no differences indicates that the youngest, or three-year-old, group studied is performing at a level equal to the other three age groups studied. Thus the three year olds in this study have internalized phonological rules to the same degree as the 'adult' or eighteen year olds in this study.

In this same analysis a statistically significant difference ( $F = 413.01$ ;  $F_{.05} = 3.84$ ;  $df = 1, 152$ ) was found between the total number of English not-words accepted through auditory perception and those verbally produced. Finding this difference indicates that individuals from the age of three years show a greater tendency to extend phonological rules when creating new words than when selecting words (half following phonological rules for the English language and the other half not). Referring again to Tables 3 and 4, it can be observed that the subjects produced only fifteen not-English words (out of a possible 800 verbal responses) whereas they chose 357 not-English words when the stimuli were presented auditorily.

There are three possible explanations for this difference in performance. First, it is possible that the task as designed by the investigator was not testing the extension of phonological rules through auditory perception. Thus the results could be attributable to chance. Secondly, the nonsense pictures may have influenced the responses of some of the subjects. Since the pictures were unusual, the subjects may have chosen the more unusual name.

Finally, and following the proposal by Brown, Joos, Swadesh, and Whorf, it is possible that the subjects converted the heard non-English phonemic patterns into possible English phonemic patterns. Thus all the stimuli sounded 'right' according to their linguistic systems. The investigator can cite many instances of this behavior. Often the subjects would not say 'first' or 'second' as per instructions, but would repeat the words. The nonsense word \*/ŋik/ was usually repeated as \*/nik/, the nonsense word "\*/gniv/" as \*/niv/, and the nonsense word "\*/pwen/" as \*/plen/, etc. If this explanation is the case, even three-year-old youngsters convert heard speech into possible English phonemic patterns conforming with their linguistic systems.

The interaction between ages and type of response was not significant.

An F test revealed no difference among the four age groups on the verbal production task (see Table 8), and another F test revealed no statistically significant difference among the four age groups on the auditory perception task (see Table 9).

### Summary

In summary, the statistical analyses revealed no statistically significant performance differences between males and females, and among age groups in regard to the internalization of phonological rules. A statistically significant difference was observed between the extension of rules by verbal production

TABLE 8. Summary of analysis of variance evaluating differences among the four age groups regarding the production of English not-words.

Source	df	ss	ms	F	F <sub>.05</sub>
Between Groups	3	.94	.31	1.24	2.73
Within Groups	76	19.25	.25		
Total	79	20.19			
F ratio: $\frac{ms_{\text{bet}}}{ms_{\text{within}}}$					

TABLE 9. Summary of analysis of variance evaluating differences among the four age groups regarding the acceptance of English not-words through auditory perception.

Source	df	ss	ms	F	F <sub>.05</sub>
Between Groups	3	16.74	5.58	1.70	2.73
Within Groups	76	249.15	3.28		
Total	79	265.89			
F ratio: $\frac{ms_{\text{bet}}}{ms_{\text{within}}}$					

and the extension of rules by auditory perception, the former task showing a greater conformity to possible English phonemic patterns. Three possible explanations for this difference were cited.

## CHAPTER IV

### DISCUSSION

#### Discussion of results

As noted in the previous chapter, there were no statistically significant differences found between the performances of males and females in the four experimental groups for either of the experimental tasks. This result is in accord with the findings of Berko (1), who also found no male-female performance difference in her study of the internalization of morphological rules by children. From these results it would appear that males and females within the four age groups tested are equal in their ability to handle both phonological and morphological rules. This equality in performance is contrary to the more often described trend of female superiority in 'language skills' (3) (18) (38) (39) (51). In light of these results, it appears to be of great importance to distinguish consistently between the terms 'language' and 'speech' which so often are used interchangeably. Carroll (10) presents the linguist's view in defining the two terms by stating that 'language' refers to a "system...which underlies the actual manifestation of motor behavior we call speech." 'Speech,' on the other hand, refers to "the behavior of...individuals in using language, the amount of talking, the conditions under which talking is elicited, and so forth."

Carroll further states: "Studying sentence length is studying speech, not language; studying the development of noun and verb inflections and of syntactical patterns, however, is studying language." Thus though there are trends toward female superiority in speech skills (articulation proficiency, size of vocabulary, sentence length, etc.), no such difference is apparent between males and females above the age of three in language learning.

A second finding of this study was the lack of significant differences between the performances of three-year-olds and eighteen-year-olds regarding the internalization of phonological rules. From this, it may be assumed that by the age of three, normal youngsters have abstracted the phonological rules from heard speech, and are able to follow these rules. Therefore, an enormous amount of language learning has occurred within the first three years of life. This finding places even greater emphasis than is generally noted on the importance of language stimulation during infancy and the early years, for it is apparent that during these years not only are the fundamentals of speech skills established, but also developed are the basic aspects of language which result in the fluent usage of that language and the generation of new words, sentences, etc., conforming to the language.

An additional finding of this study was that there are significant differences within all age groups between following phonological rules by making up words, and following the rules when accepting heard speech. As previously mentioned in Chapter III, several factors, in isolation or combination, could have influenced

these results. First, it is possible that requesting the subjects to select the 'better' word for the nonsense picture is not testing the same process as requesting them to select the English word for the picture. However, it is questionable whether a three-year-old would understand the latter instruction. The results (of the perception task), which can be attributed to chance, may therefore have been influenced by the directions given.

Secondly, because the pictures used as stimuli were unusual, the 'better' word may have been the word which sounded more unusual, a strange word being associated with a strange picture. Yet, if phonological rules were being followed, this second factor could not have been an isolated, consistent influence on all subjects because then an acceptance of all not-English phonemic patterns (the more unusual word) would have resulted. However, since it cannot be assumed that all pictures were of equal unusualness, a strange-sounding word may have been selected for the extremely unusual pictures, while a more familiar sounding word may have been selected for the less unusual pictures. This again would result in findings that could be attributed to chance.

Finally, it is possible that, as early as age three, people tend to hear speech in terms of their own linguistic systems. Since phonological rules are followed (as noted through verbal production) by the age of three, the phonemic patterning of the language has been internalized, and therefore not-English phonemic sequences may be heard as possible English phonemic sequences. This factor would

then also result in findings that could be attributed to chance, as both of the words in the pair sounded 'English.' Moreover, this factor is strongly supported by the fact that many subjects repeated the not-English phonemic sequences as English phonemic sequences. That speech may be heard in terms of one's own linguistic system as early as the age of three would emphasize further the amount of language learning that takes place prior to age three. This third interpretation, while not suggesting that the perceptive control of phonological rules precedes the productive control as did Berko and Brown (2), does suggest that the two avenues for extending phonological rules are both developed by the age of three.

#### Observations

It is of interest to note that the reactions of the different age groups to the verbal production task varied considerably. Subjects in Groups C and D often stated that it was impossible to make up new words, indicating in some way that all possible words had been formed. Thus language to them was finite and static. Though many of these subjects commented on the difficulty of the task, with encouragement they were able to complete it.

In contrast, the subjects in Group B proceeded to complete the task with little comment once the task was understood. In Group A, many of the youngsters tested, while fulfilling all subject criteria, would not perform the task, and therefore could not be used as subjects. With inquiry, the parent explained that, while

the child did make up new words at home, he was discouraged from doing so because it was 'silly' behavior. Thus if a child were discouraged by his parents from behaving in a certain manner, it is understandable that he would not behave in that same manner when encouraged to do so by the investigator. Such behavior on the part of the parent is indicative of the language teaching process. Patterns conforming to the parents' language are encouraged, while 'not-right' language from the child is discouraged.

#### Implications for further research

It would be beneficial to note the results of research which used different methods to study the extension of phonological rules through production and perception. The avenues of reading and writing might be utilized with the older subjects. That is, when reading pairs of nonsense syllables, some with possible English phonemic sequences and some with not-English phonemic sequences, would the subjects select the English not-words? Similarly, would subjects reveal a tendency to produce different numbers of not-English words when writing than when speaking? Another aspect to study is the nature of the repetition of the not-English sequence by subjects. A stimulus-response situation using not-English words as the stimuli may offer more information regarding hearing not-English phonemic sequences as possible English phonemic sequences. Finally, play sessions with three-year-olds may elicit word forming behavior which would offer additional information to that obtained in the more structured situation.

In addition to further study using normal children, it would

be of interest to note any differences that may exist in the internalization and extension of phonological rules by subjects with articulation problems, mental retardation, etc. Have youngsters with articulation problems internalized the phonological rules of the language to the same extent as normal speaking children? Winitz (53) suggests that "functional articulation errors represent the incorrect learning of the phonemic system of the language." Furthermore, Lewis (37), in formulating a rule for sound substitution, states that "substitution occurs when the child replaces a heard consonant by one relatively more familiar, one which has been longer established in his repertory." From these statements it is possible to hypothesize that children with functional articulation disorders have internalized only some of the phonological rules, and in following them, produce only some of the possible English phonemic sequences. Further study in this area may offer information regarding a possible etiology of functional articulation disorders and a basis for a plan of therapy. Studying the internalization of phonological rules by mentally retarded children not only would offer added insight into the language development process of the mentally retarded, but may also be applicable to normal language development. The internalization process in mental retardates may be simply a deceleration of the normal process.

## CHAPTER V

### SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate the extension of internalized phonological rules as a function of the sex and chronological age of the 'average' normal child.

To carry out this purpose, eighty subjects, divided into four groups of ten males and ten females each, were selected from three grades and the waiting list of P.K. Yonge Laboratory School. From specific test results it was determined that all subjects were of about 'average' intelligence, and had hearing acuity, articulation, and auditory discrimination ability within normal limits for their chronological age. In addition, American English was the native language of all the subjects, and it was the only language spoken in the homes of the subjects. The groups differed only in chronological age, the ages being three, six, thirteen, and eighteen years respectively for the Groups A-D. Group D was considered to be of 'adult' age.

The experimental tasks made use of twenty-two nonsense pictures which were chosen by ten judges from fifty nonsense pictures drawn by a college student majoring in art. The ten judges independently selected the nonsense pictures which to them least resembled any known object or being. The resulting twenty-two pictures were

then used as visual stimuli, serving as a point of reference from which the subjects auditorily perceived and created nonsense words.

For the verbal production task, the subjects created ten original words, one for each of ten nonsense pictures. Two nonsense pictures were available if examples were necessary. Each of the 800 original words was examined for not-English phonemic patterning, and each subject obtained a score equal to the number of words he created with possible English phonemic patterning.

In the auditory perception task, for each of ten nonsense pictures, each subject listened to the investigator repeat two nonsense words which differed in initial consonant but were similar in medial vowel and final consonant. One word of each pair had a not-English phonemic pattern in the initial position, and the other nonsense word had a possible English phonemic pattern. The position of the English and not-English combinations in the pair was randomly ordered. The nonsense words chosen were those used by Brown and Hildum (9), with two modifications accountable by language change. Each subject chose one of the words of the pair which to him was the better word for the nonsense picture. A score equal to the number of words chosen with possible English phonemic patterning was determined for each subject.

The data were analyzed statistically to determine the presence of male-female performance differences, age performance differences, and differences between the internalization of phonological rules as noted through verbal production and auditory perception.

Based on the results of this investigation, three conclusions were reached.

1. There is no difference between the performance of males and females, within any of the four age groups tested, in regard to the extension of internalized phonological rules.

2. There is no difference in performance among the four age groups tested in regard to the extension of internalized phonological rules.

3. There is a difference within all four age groups between the verbal production and auditory perception tasks, the former task more clearly showing an adherence by the subjects to phonological rules.

## BIBLIOGRAPHY

## BIBLIOGRAPHY

1. Berko, J., The child's learning of English morphology. In S. Saporta (Ed.), Psycholinguistics. New York: Holt, Rinehart and Winston, Inc., 1961.
2. Berko, J., and Brown, R., Psycholinguistic research methods. In P. Mussen (Ed.), Handbook of Research Methods in Child Development. New York: John Wiley and Sons, Inc., 1960.
3. Berry, M., and Eisenson, J., Speech Disorders. New York: Appleton-Century-Crofts, Inc., 1956.
4. Bloomfield, L., A set of postulates for the science of language. In S. Saporta (Ed.), Psycholinguistics. New York: Holt, Rinehart and Winston, Inc., 1961.
5. Bloomfield, L., Language. New York: Holt, Rinehart and Winston, 1933.
6. Brown, R., Words and Things. Illinois: The Free Press, 1958.
7. Brown, R., Linguistic determinism and the part of speech. Journal of Abnormal and Social Psychology, 55, 1957, 1-5.
8. Brown, R., Language and categories. Appendix to Bruner, J., Goodnow, J., and Austin, G., A Study of Thinking. New York: John Wiley and Sons, Inc., 1956.
9. Brown, R., and Hildum, D., Expectancy and the perception of syllables. Language, 32, 1956, 411-419.
10. Carroll, J., Psycholinguistics in the study of mental retardation. In R. Schiefelbusch and J. Smith (Ed.), Research in Speech and Hearing for Mentally Retarded Children. Kansas: Bureau of Child Research. U. S. Office of Education Project No. F 010, 1963.
11. Carroll, J., The Study of Language. Cambridge: Harvard University Press, 1961.
12. Carroll, J., Language development in children. In S. Saporta (Ed.), Psycholinguistics. New York: Holt, Rinehart and Winston, Inc., 1961.

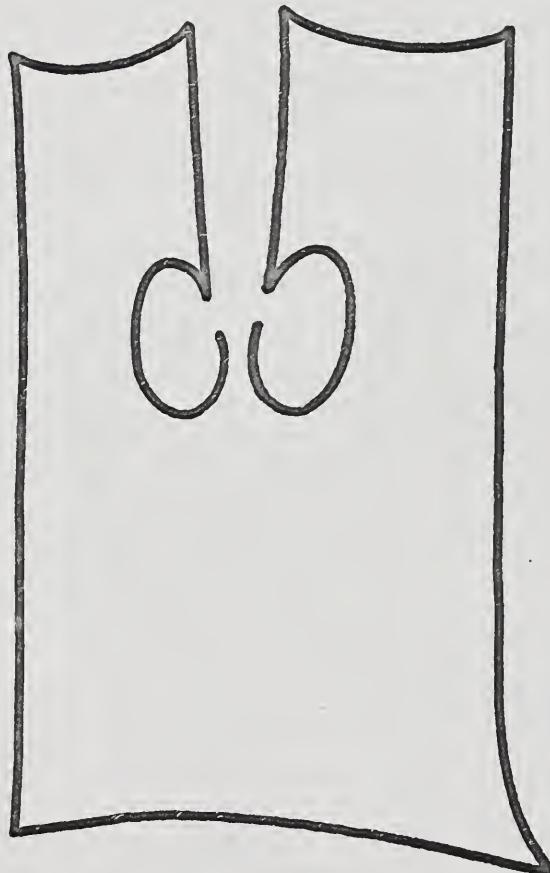
13. Carroll, J., The assessment of phoneme cluster frequencies. Language, 34, 1958, 267-278.
14. Cherry, C., On Human Communication. New York: Science Editions, Inc., 1961.
15. Chomsky, N., Syntax and semantics. In S. Saporta (Ed.), Psycholinguistics. New York: Holt, Rinehart and Winston, Inc., 1961.
16. Clark, W., and Tiegs, E., California Short-Form Test of Mental Maturity. California: California Test Bureau, 1957.
17. Contreras, H., and Saporta, S., The validation of a phonological grammar. Lingua, 9, 1960, 1-15.
18. Davis, E., The development of linguistic skill in twins, singletons with siblings and only children from age 5-10 years. Institute of Child Welfare Monograph, 14, 1937.
19. Dewey, G., Relativ Frequency of English Speech Sounds. (sic) Cambridge: Harvard University Press, 1923.
20. Diebold, R., Incipient bilingualism. Language, 37, 1961, 97-112.
21. Dunn, L., Peabody Picture Vocabulary Test. Minnesota: American Guidance Service Inc., 1959.
22. Fries, C., The Structure of English. New York: Harcourt, Brace and Co., 1952.
23. Fries, C., and Pike, K., Coexistent phonemic systems. Language, 25, 1949, 29-50.
24. Glanzer, M., Toward a psychology of language structure. Journal of Speech and Hearing Research, 5, 1962, 303-314.
25. Halle, M., Phonology in generative grammar. Word, 18, 1962, 54-72.
26. Harris, Z., Simultaneous components in phonology. Language, 20, 1944, 181-205.
27. Haugen, E., The Analysis of linguistic borrowing. Language, 26, 1950, 210-231.
28. Hayden, R., The relative frequency of phonemes in general-American English. Word, 6, 1950, 217-223.

29. Hejna, R., Developmental Articulation Test. Wisconsin: College Typing Co., 1959.
30. Henry, W., Projective techniques. In P. Mussen (Ed.), Handbook of Research Methods in Child Development. New York: John Wiley and Sons, Inc., 1960.
31. Hockett, C., Age-grading and linguistic continuity. Language, 26, 1950, 449-457.
32. Ivanov, V., Cybernetics and the science of language. Modern Language Journal, 46, 1962, 158-159.
33. Jakobson, R., and Halle, M., Fundamentals of Language. 'S-Gravenhage: Mouton and Co., 1956.
34. Joos, M., Acoustic phonetics. Language Monograph Supplement #23, 24, 1948, 63.
35. Leopold, W., Patterning in children's language learning. Language Learning, 5, 1953-1954, 1-14.
36. Lerea, L., Assessing language development. Journal of Speech and Hearing Research, 1, 1958, 75-85.
37. Lewis, M., Infant Speech. New York: The Humanities Press, Inc., 1951.
38. McCarthy, D., Some possible explanations of sex differences in language development and disorders. Journal of Psychology, 35, 1953, 155-160.
39. Milisen, R., The incidence of speech disorders. In L. Travis (Ed.), Handbook of Speech Pathology. New York: Appleton-Century-Crofts, Inc., 1957.
40. Moser, H., One-Syllable Words - Revised and Arranged by Ending Sounds. AFCCDD TN 60-58, R F Project 882, Technical Report 53, 1960.
41. Osgood, C. (Ed.), Psycholinguistics. Journal of Abnormal and Social Psychology Supplement, 49, 1954, 137.
42. Sapir, E., Sound patterns in language. Language, 1, 1925, 37-51.
43. Saporta, S., Frequency of consonant clusters. Language, 31, 1955, 25-30.
44. Strang, B., Modern Language Structure. Edward Arnold, Ltd., 1962.

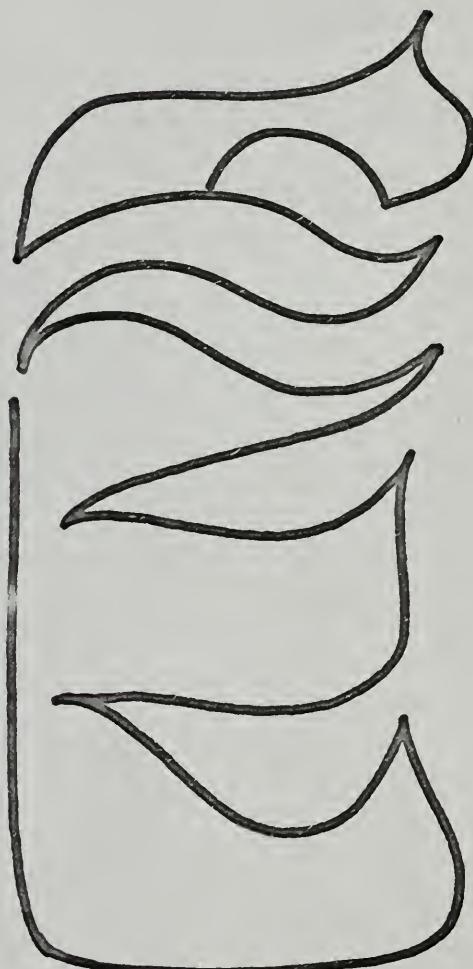
45. Sullivan, E., Clark, W., and Tiegs, E., California Short-Form Test of Mental Maturity. California: California Test Bureau, 1957.
46. Swadesh, M., The phonemic principle. Language, 10, 1934, 117-129.
47. Templin, M., Certain Language Skills in Children. Minnesota: The University of Minnesota Press, 1957.
48. Velten, H., The growth of phonemic and lexical patterns in infant language. Language, 19, 1943, 281-292.
49. Weinreich, U., On the description of phonic interference. Word, 13, 1957, 1-11.
50. Wepman, J., Auditory Discrimination Test. Illinois: The University of Chicago, 1958.
51. West, R., Ansberry, M., and Carr, A., The Rehabilitation of Speech. New York: Harper and Brothers, 1957.
52. Whorf, B., Language, Thought and Reality. New York: John Wiley and Sons, Inc., 1956.
53. Winitz, H., Toward a refocus of functional articulation research. ASHA, 5, 1963, 789.



Verbal production procedure; example A: "\*wug".



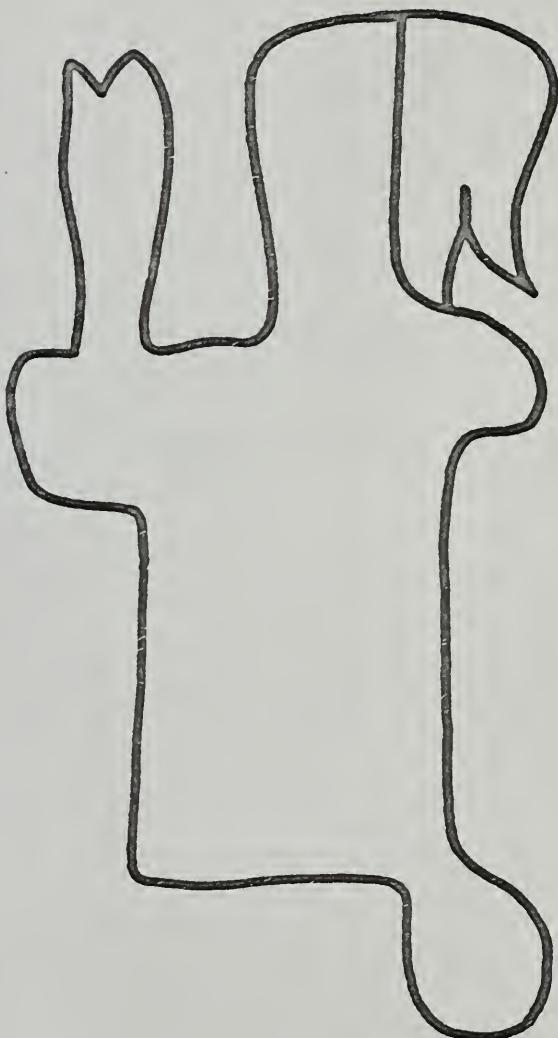
Verbal production procedure; example B: \*klof.



Verbal production procedure; picture #1.



Verbal production procedure; picture #2.



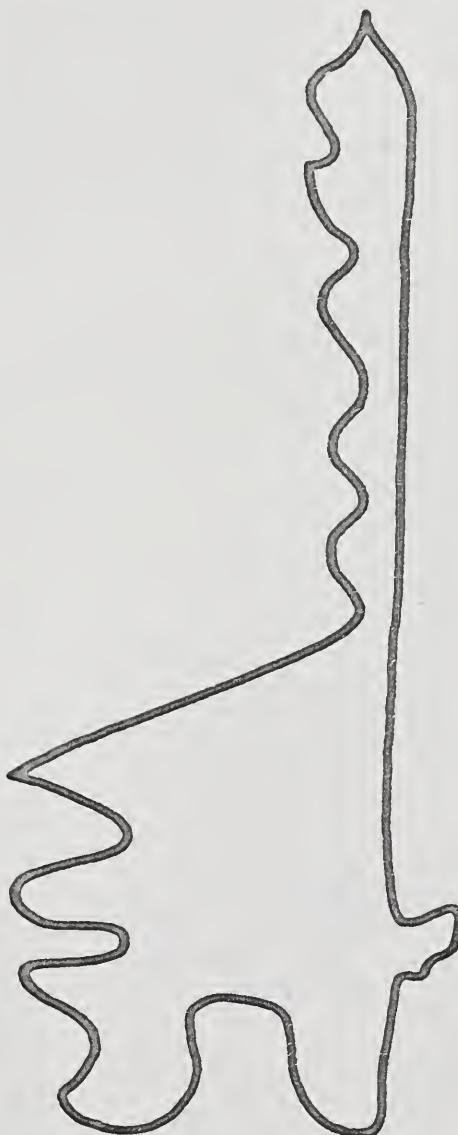
Verbal production procedure; picture #3.



Verbal production procedure; picture #4.



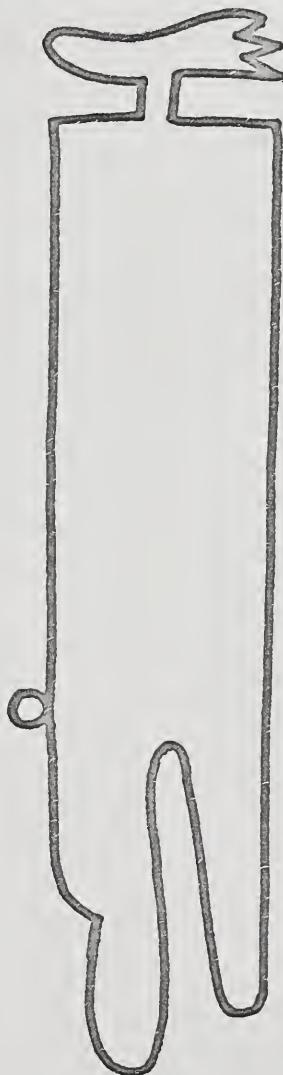
Verbal production procedure; picture #5.



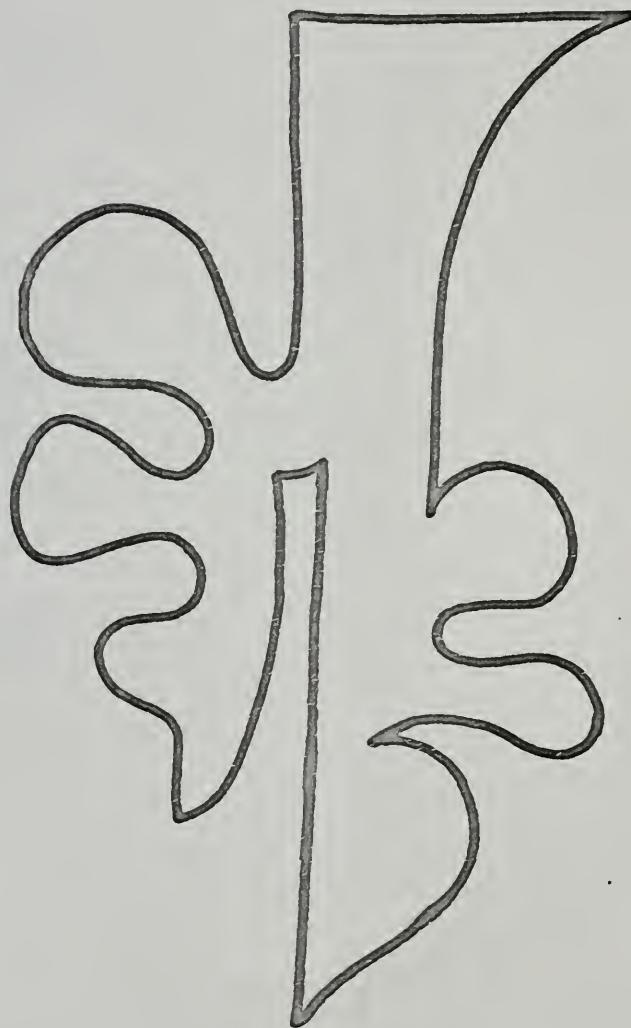
Verbal production procedure; picture #6.



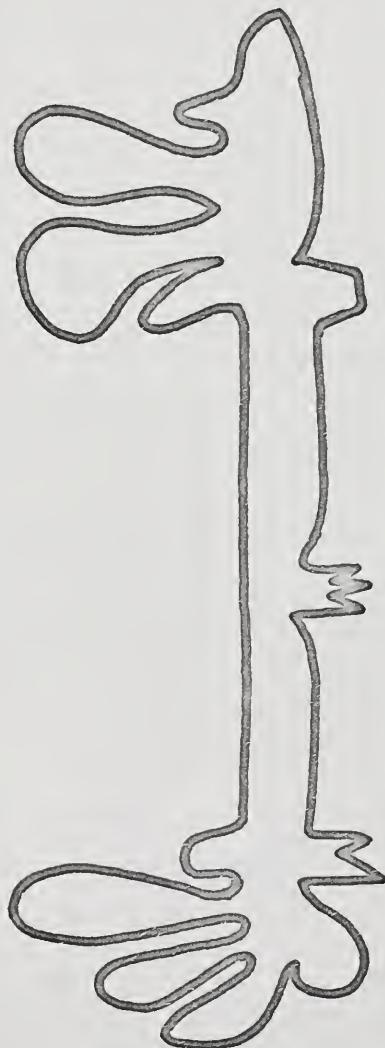
Verbal production procedure; picture #7.



Verbal production procedure; picture #8.



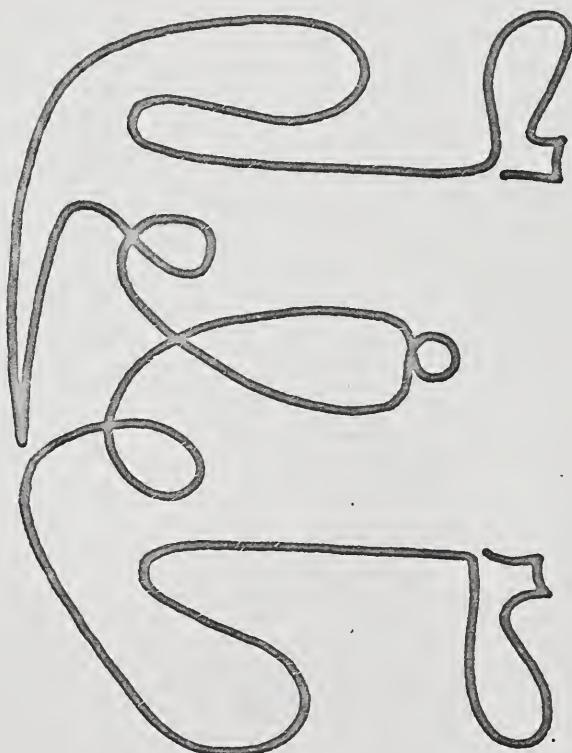
Verbal production procedure; picture #9.



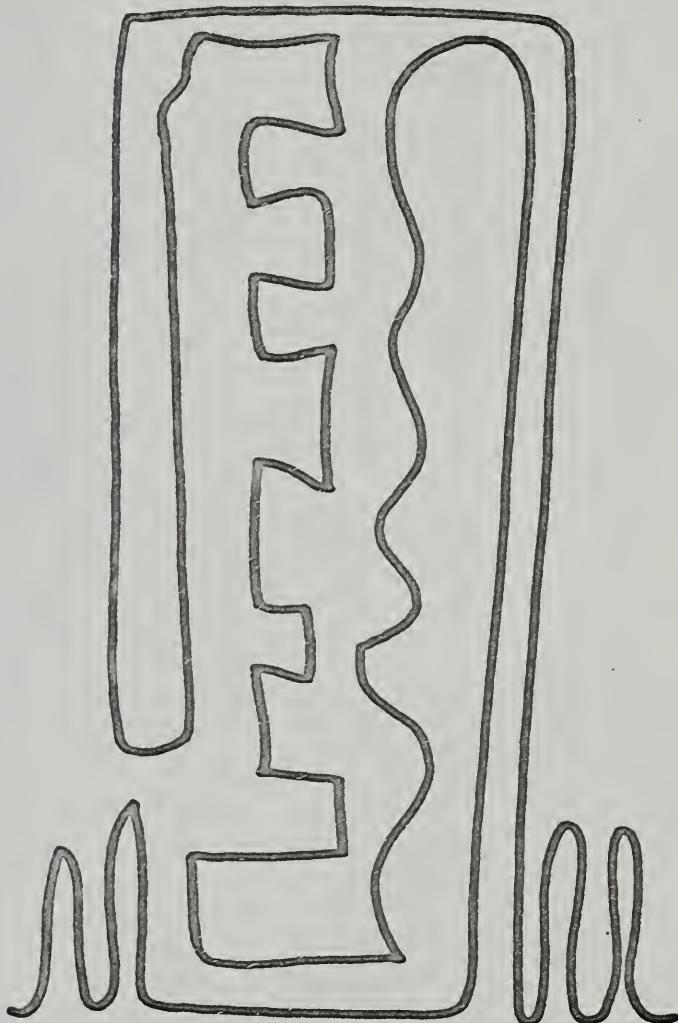
Verbal production procedure; picture #10.



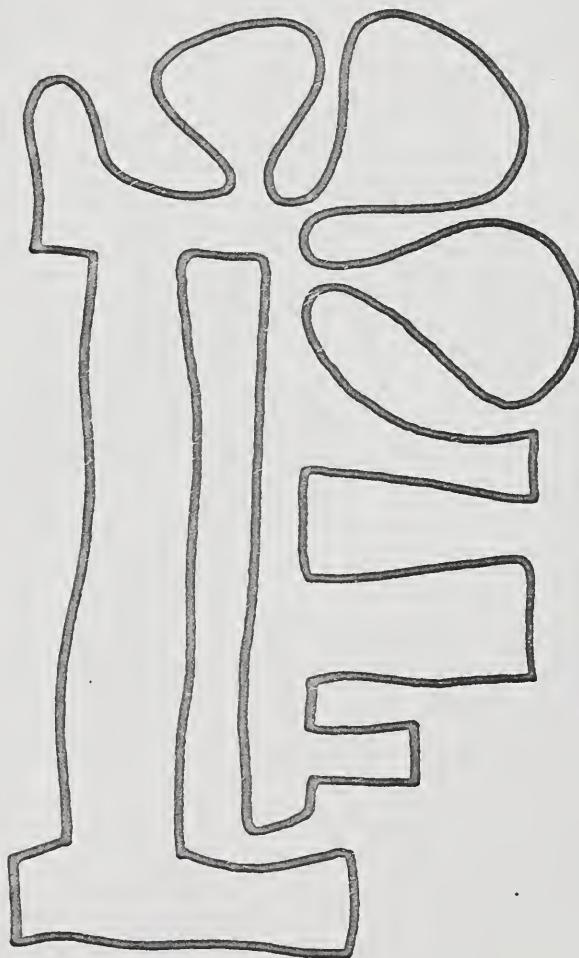
Auditory perception procedure; picture #1.



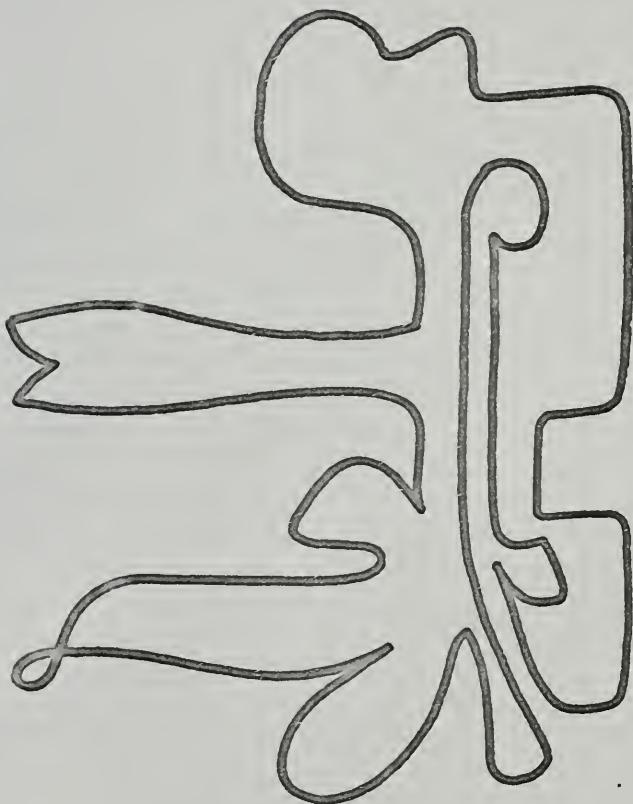
Auditory perception procedure; picture #2.



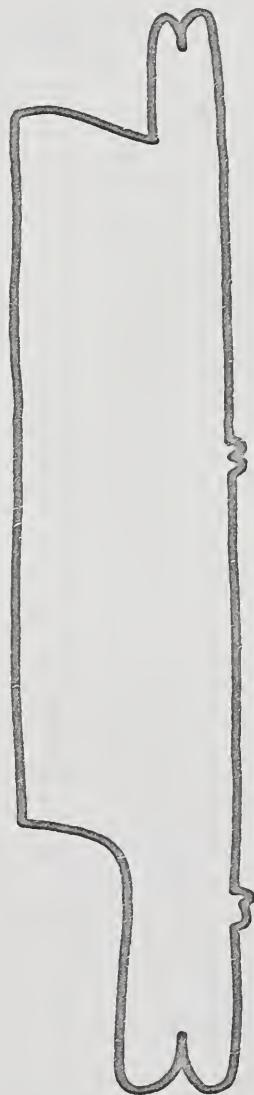
Auditory perception procedure; picture #3.



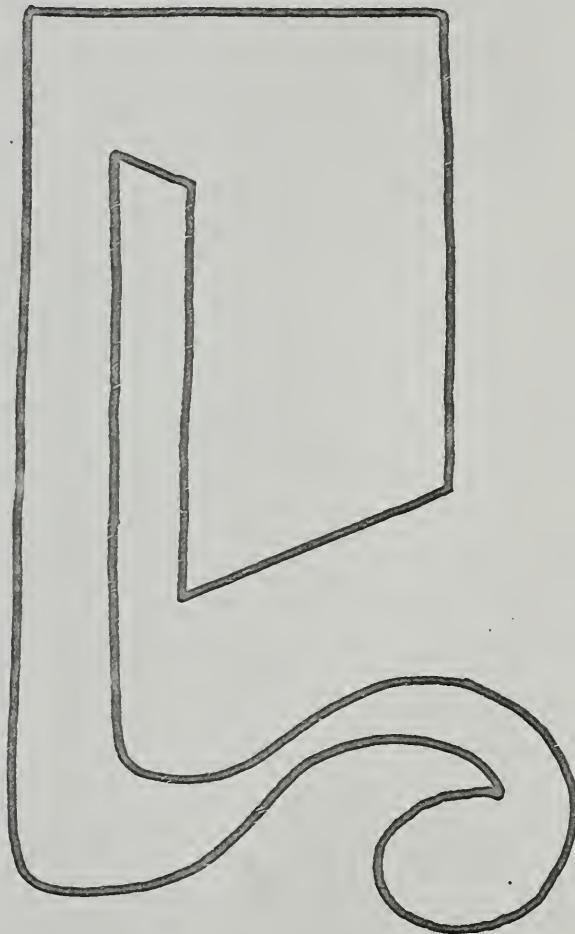
Auditory perception procedure; picture #4.



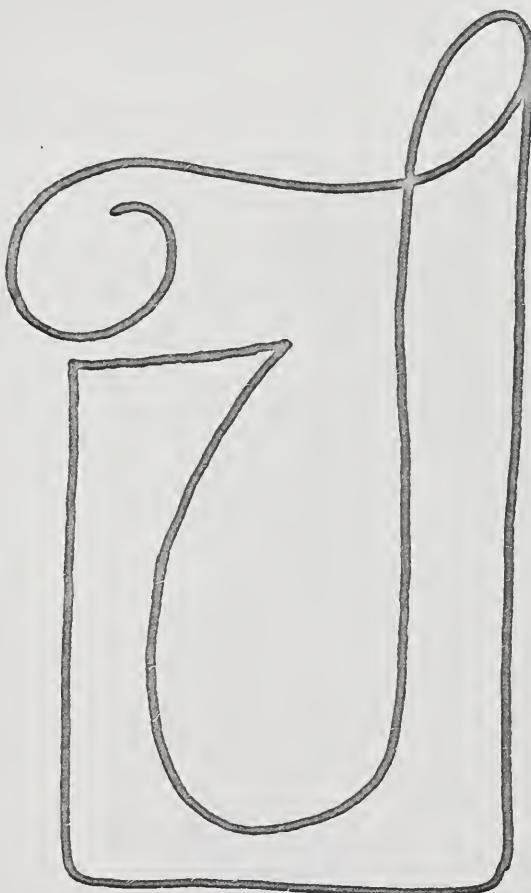
Auditory perception procedure; picture #5.



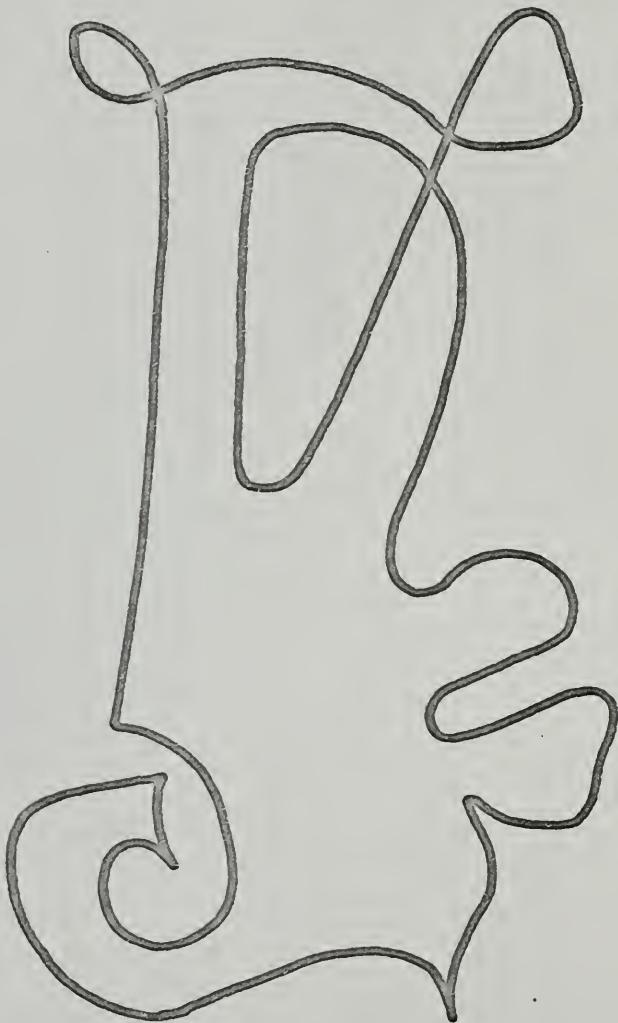
Auditory perception procedure; picture #6.



Auditory perception procedure; picture #7.



Auditory perception procedure; picture #8.



Auditory perception procedure; picture #9.



Auditory perception procedure; picture #10.



The nonsense words used in the auditory perception procedure are a modification of the words by Brown and Hildum. The words are listed by pairs in the position presented during the testing procedure.

1.	"*/zdroł/"	"*/prøl/"
2.	"*/pwen/"	"*/klen/"
3.	"*/θrup/"	"*/pʃup/"
4.	"*/trik/"	"*/ŋik/"
5.	"*/skaɪs/"	"*/fwaɪs/"
6.	"*/kpet/"	"*/dret/"
7.	"*/vmoǔv/"	"*/sloǔv/"
8.	"*/spɪb/"	"*/tlɪb/"
9.	"*/θriv/"	"*/gniv/"
10.	"*/tʃluf/"	"*/gluf/"

## List of Not-English Words Produced

1. \*/ŋgu/
2. \*/zra/
3. \*/nreet/
4. \*/klɪfk/
5. \*/tʃrʌg/
6. \*/dʒrəd/
7. \*/bʌrʌŋ/ (rolled /r/)
8. \*/ʃtrængəl/
9. \*/ʃɪmk/
10. \*/vrɪnibəd/
11. \*/ʃtreendɪf/
12. \*/tɪln/
13. \*/dʌh/
14. \*/lɪnft/
15. \*/dluk/

March 17, 1965

Dear Mr. and Mrs.

As part of the requirements for the degree Doctor of Philosophy, I am conducting a study in normal language development. Mr. Henderson, Principal of P.K. Yonge Laboratory School, has agreed for students now enrolled in his school to participate in the study.

The name of your child, \_\_\_\_\_, has been obtained from the waiting list of three year old youngsters who have applied for enrollment at P.K. Yonge. I would like to invite you to participate in this study. As part of the research procedure, \_\_\_\_\_ would be given both speech and hearing screening tests. The research will be conducted at the Speech Clinic of the University of Florida, room 326, Tigert Hall. The study would require approximately one hour, and would be scheduled at your convenience. Results of the speech and hearing tests will be given to you upon request.

Participation in this study, and the information obtained thereof, will in no way influence the enrollment procedure of P.K. Yonge. I hope that you will agree to have your child participate in this study. I will be calling you in the near future, and will be happy to answer any questions you may have concerning this study.

Very truly yours,

S/Lorraine I. Michel

Lorraine I. Michel

Approved:

S/Chas. A. Henderson

Chas. A. Henderson  
Principal, P.K. Yonge

S/McKenzie W. Buck

McKenzie W. Buck, Ph.D.  
Head, Speech Pathology  
University of Florida

#### BIOGRAPHICAL SKETCH

Lorraine June Michel, nee Ivison, was born June 21, 1938, in Flushing, New York. In June, 1955, she was graduated from Bayside High School. Majoring in speech, she received the degree Bachelor of Arts from Adelphi University in June, 1959. Mrs. Michel then worked as a graduate assistant in the Department of Speech of The Ohio State University, receiving her Master of Arts degree in June, 1960. She was employed as a speech therapist in Wichita, Kansas, from 1960 until 1962. In September of 1962 she enrolled in the Graduate School of the University of Florida. While pursuing her work toward the degree of Doctor of Philosophy, she worked as a graduate assistant in the Department of Speech until September, 1963, and has had a Vocational Rehabilitation Administration Traineeship until the present time.

Lorraine Ivison Michel is married to John Frederich Michel. She is a member of the American Speech and Hearing Association, the Florida Speech and Hearing Association, and Sigma Alpha Eta.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 14, 1965

Ernest H. Cox  
Dean, College of Arts and Sciences

---

Dean, Graduate School

Supervisory Committee:

McKenzie W. Brack  
Chairman

Paul Moore

Paul J. Jensen

Richard J. Muller, Jr.

Audrey L. Schumacher

3202 1425